Space Weather Technical Forecast

Issued on Friday, 26 July 2024 at 12:54 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

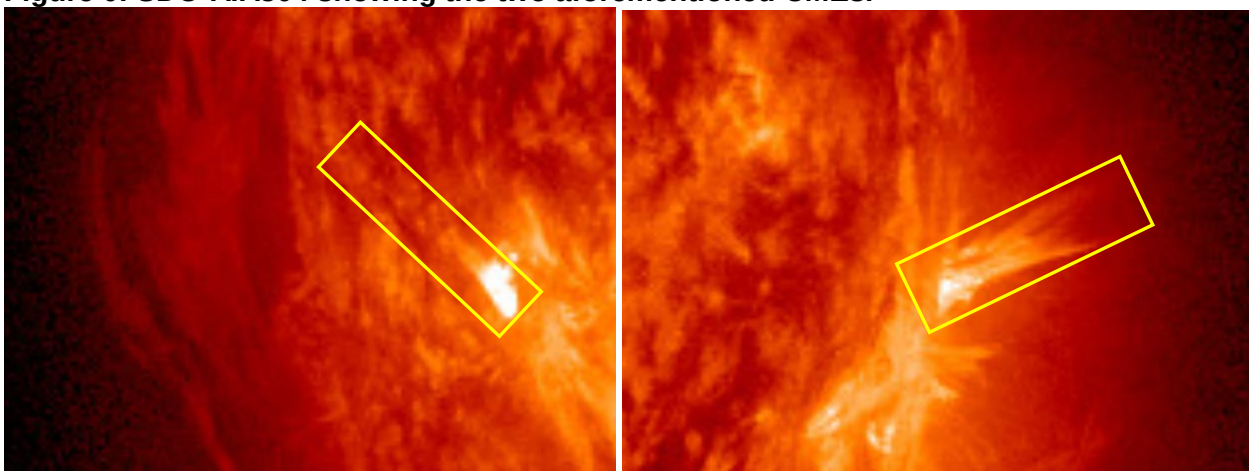
Space Weather Forecast Headline: Chance of G1/Minor Storms Days 1 and 2 (26-27 Jul). Chance of R1 Radio Blackouts throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity was Moderate, with an M1.3 observed at 25/1537 UTC from AR3751 and an M1.7 observed at 26/0442 UTC from AR3761. There are currently eleven sunspot regions on the solar disc. AR3751, which has been one of the most active regions, has now rotated around the southwest limb. Right behind it is AR3761, also approaching the southwest limb whilst continuing to show signs of decay in its trailing spots. AR3762 is still by far the largest and most complex region. It has now moved into the southwest quadrant and continues to show a proliferation of spots in its leading and intermediate portions, including a tenuously weak Mt Wilson Delta spot. There is a cluster of small and relatively simple regions in the centre east, including the newly numbered AR3767. A new and currently unnumbered region has emerged to the east of AR3762, as well as in the northwest limb. All other remaining regions appear small, simple and/or largely unchanged.

A couple of minor CMEs were seen leaving the sun on SDO-AIA304 imagery but none are considered to be Earth-directed. The first one was observed shortly after the C1.6 flare that came from AR3767 around 25/2240 UTC. The second one was observed shortly after the C7.4 flare that came from AR3751 (now far-sided) around 26/0151 UTC. A small ejecta was also spotted around 26/0130 UTC but it was not sufficiently visible on Coronagraph imagery to be analysed.

Figure 0: SDO-AIA304 showing the two aforementioned CMEs.



Solar Wind / Geomagnetic Activity: An unexpected CME most likely arrived at Earth early in the period. The solar wind, as measured by ACE at L1, rose from 330 km/s to 520 km/s, briefly peaking at 600 km/s around 26/0530 UTC. Density remained well below average. The Interplanetary magnetic field (IMF), Bt, was Moderate to Strong, briefly peaking at 20nT around

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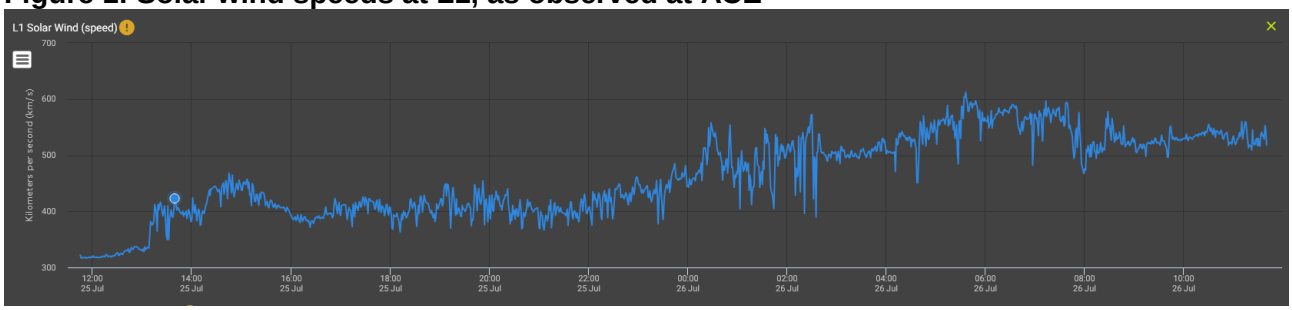
25/2320 UTC, then back to weak since 26/0530 UTC. The north-south component, Bz, became fairly erratic, fluctuating between -14nT to +15nT, but much weaker since 26/0530 UTC. The phi angle was predominately positive (away from the Sun) but became negative (towards the sun) between 26/0400-0945 UTC. The net result of the above solar wind measures was for Quiet to Active (Kp1-4) conditions with a provisional G1 / Minor Storm (Kp5) interval observed 26/0300-0600 UTC.

Figure 1: Solar wind speeds at L1, as observed at ACE



Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 has returned back to background levels after a period above S1 on 23 Jul following a large far sided full halo CME. High energy electron flux (greater than 2MeV) observed at GOES16 was at Normal Background. The 24-hour fluence was well below Active, with 1.06e6 integrated pfu observed at 26/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with a chance of further M-class flares.

Solar Wind /Geomagnetic Activity: No coronal hole fast winds feature in the forecast period. A CME arrived at Earth on 25 Jul, the effects of which should begin to wane on Day 1. However, another CME may give Earth a glancing blow late on Day 1 or perhaps early on Day 2 (26/27 July). Geomagnetic activity is expected to be Unsettled to Active with a chance of G1/Minor storms intervals late on Day 1 and perhaps early on Day 2 (26/27 July). Any CME effects waning on Day 3 (28 Jul), with activity becoming mostly Quiet.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background levels. However, there is a very slight chance of exceeding the S1/Minor Storm threshold should any notable flares occur.

The high energy electron flux may show an increasing trend in the next few days after the recent CME influence. The associated 24-hour fluence is expected to remain below the Active threshold (1e8 integrated pfu) but with a slight rising trend later in the
period.

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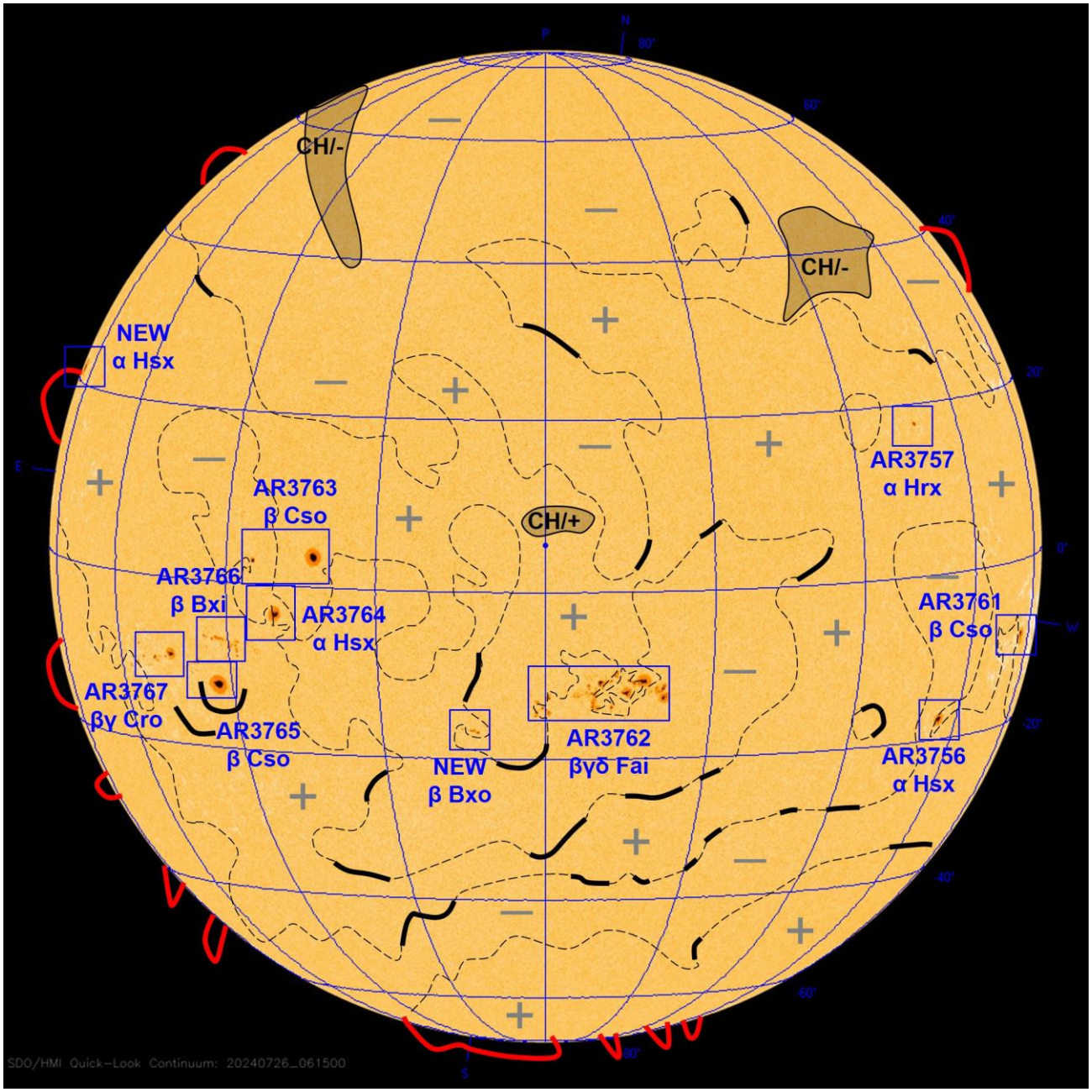
Figure 2. Solar Analysis Valid 26/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:
No coronal hole fast winds feature in the forecast period. Earth is currently under the waning influence of the magnetic cloud associated with the CME that arrived on 25 Jul. Solar winds are still elevated but the IMF is now stable and weak, most likely encouraging a return to Quiet geomagnetic activity.

However, another CME may give Earth a glancing blow. It originated from a long period M2.4 flare close to the southeast limb near AR3764 at 23/1430 UTC. This gave a wide and moderately fast CME, perhaps with low confidence of peripheral glancing impacts at Earth possible either late on Day 1 or early Day 2 (26/27 Jul).

Geomagnetic activity is expected to be Unsettled to Active with a chance of G1/Minor storms intervals late on Day 1 and perhaps early on Day 2 (26/27 July). Any CME effects waning on Day 3 (28 Jul), with activity becoming mostly Quiet.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	40	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
23/2224	Partial	Filament eruption	SE	560 km/s	26/1500 UTC +/- 12hrs	Low confidence due to location

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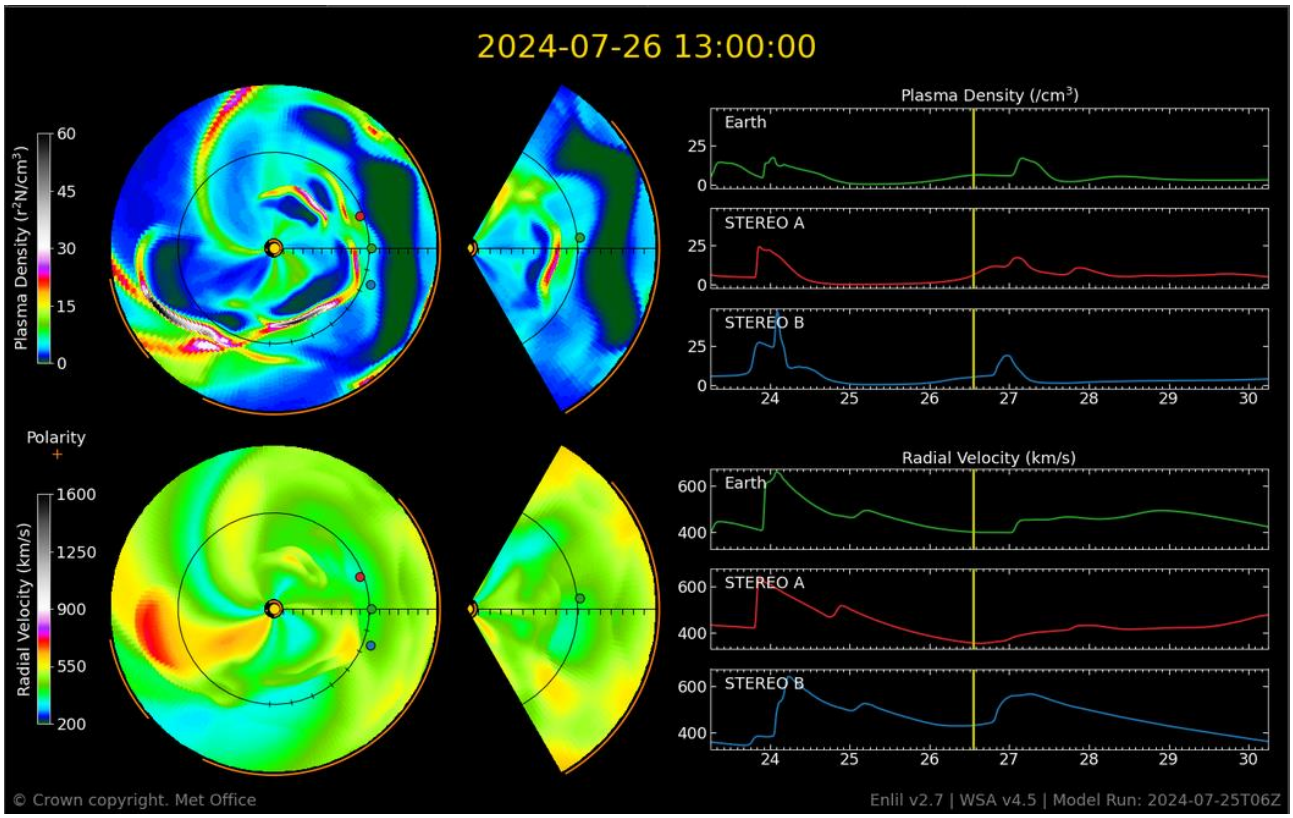
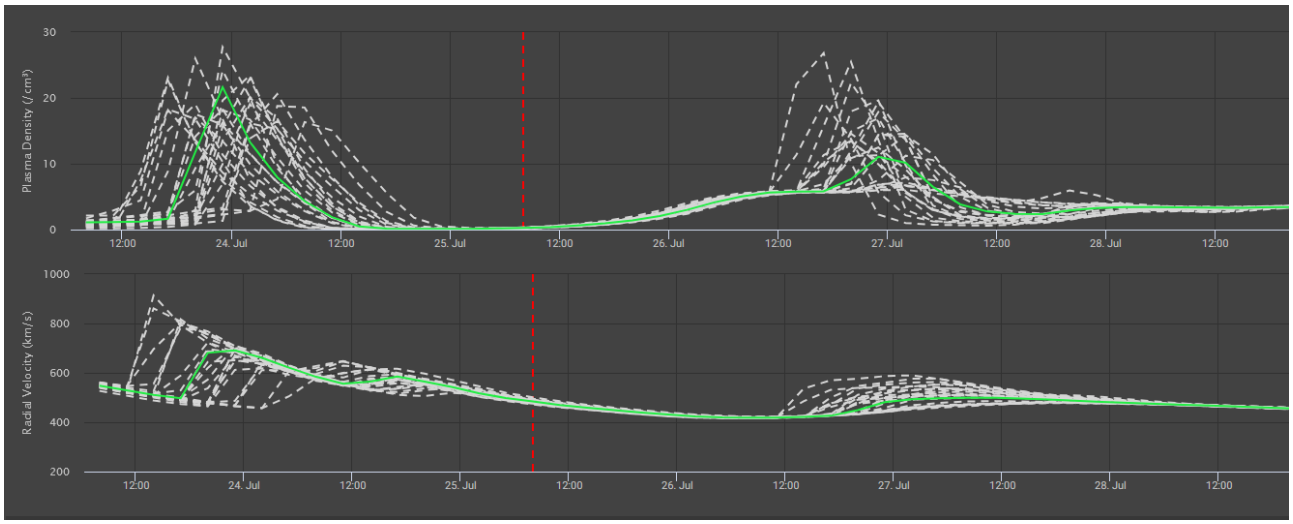
Figure 3: MOSWOC Enlil and Ensemble showing a possible CME glancing blow late 26 July or early 27 July.





Radio Blackouts - X-Ray Flares:

Activity was at the lower end of the Moderate class, with an M1.3 observed at 25/1537 UTC from AR3751 and an M1.7 observed at 26/0442 UTC from AR3761.

There are currently eleven sunspot regions on the solar disc. AR3751, which has been one of the most active regions, has now rotated around the southwest limb. Right behind it is AR3761, also approaching the southwest limb whilst continuing to show signs of decay in its trailing spots. AR3762 is still by far the largest and most complex region. It has now moved into the southwest

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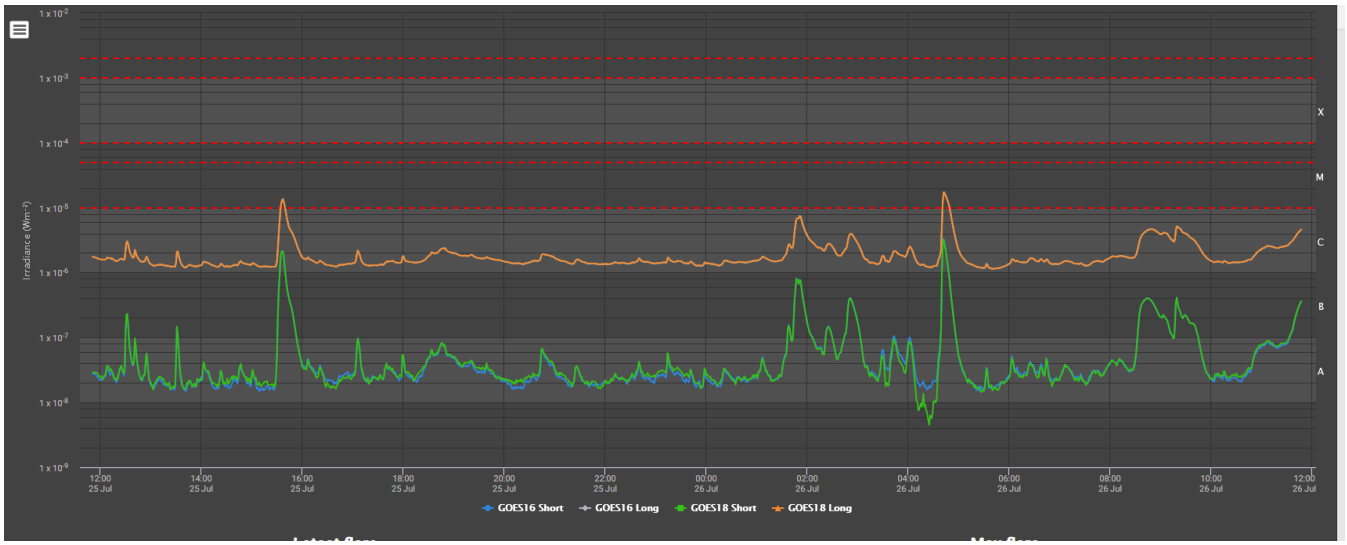
quadrant and continues to show a proliferation of spots in its leading and intermediate portions, including a tenuously weak Mt Wilson Delta spot. There is a cluster of small and relatively simple regions in the centre east, including the newly numbered AR3767. A new and currently unnumbered region has emerged to the east of AR3762, as well as in the northwest limb. All other remaining regions appear small, simple and/or largely unchanged.

Activity is expected to be Low to Moderate with a chance of further M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 4: Latest X-Ray flare activity, as observed at GOES-18



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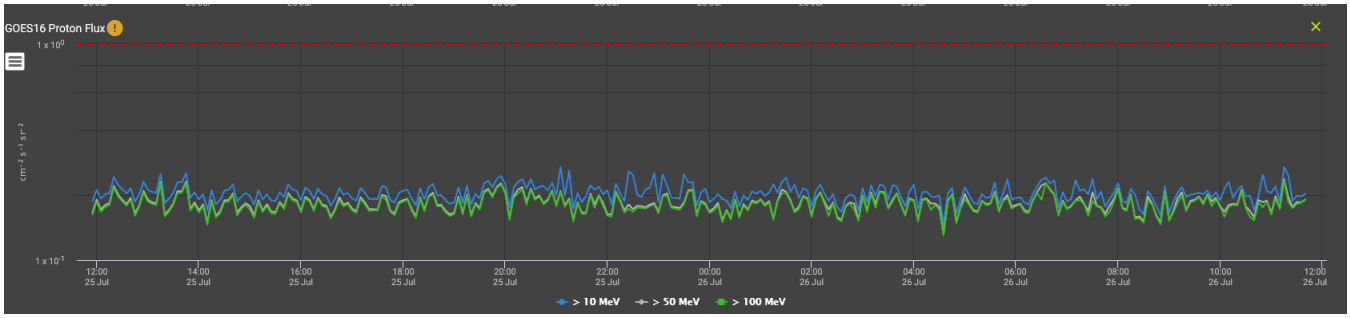
Solar Radiation Storms - (High Energy Protons):
Proton levels have returned to background levels. High energy proton levels are likely to remain at background levels, although there is a slight risk of reaching the S1 threshold if any notable flares occur throughout the remainder of the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: Latest Proton Flux, as observed at GOES-16



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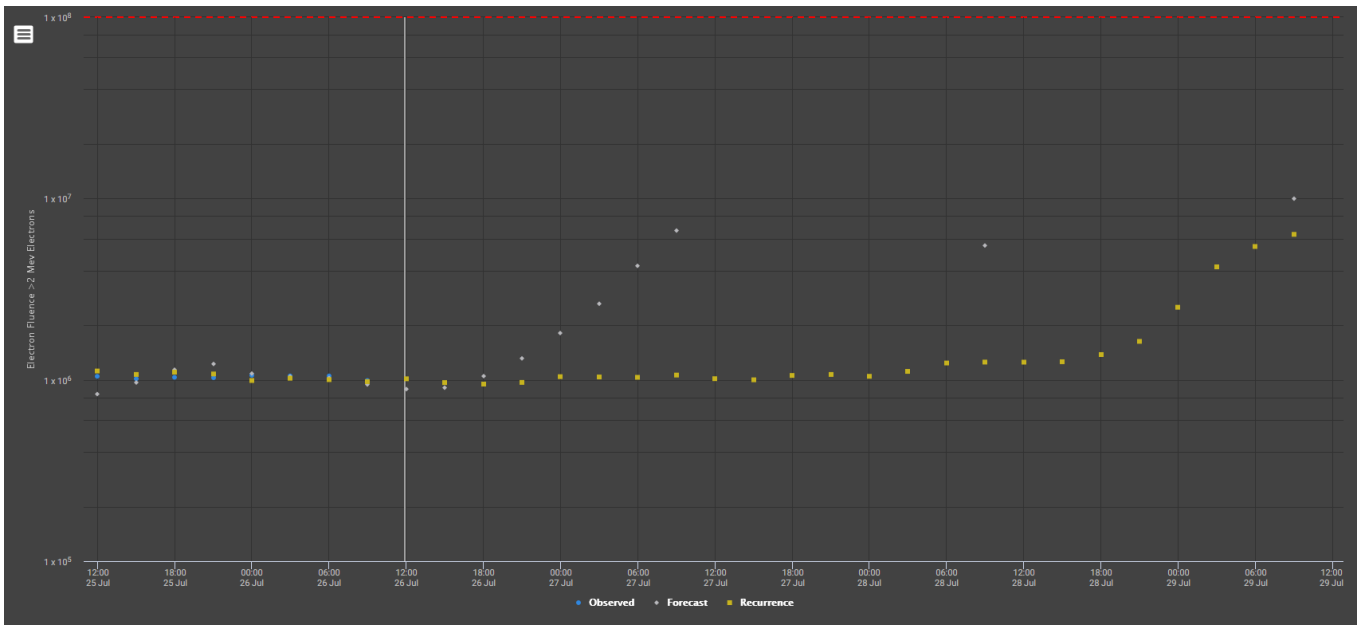
High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is expected to continue at background levels for the start of the period. The recent CME enhancement may have caused an increase in electron flux below GEO, but the potential for further CME arrivals could suppress this once again. Overall, electron flux is most likely to stay at background levels, but as the solar wind speeds decline there is the possibility of an increase to peak at moderate or perhaps high levels later in the period.

The associated electron fluence is most likely to persist below the Active threshold (1e8 integrated pfu), but with a slight rising trend later in the period. The latest MOSWOC REFM output is forecasting below Active through the next three days, which is the most probable outcome.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 6: Latest MOSWOC REFM output



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